PATENT SPECIFICATION

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818,446

Date of Application and filing Complete Specification Oct. 25, 1957.

No. 33344/57.

Complete Specification Published Aug. 19, 1959.

Index at acceptance: —**Classes 79(2)**, C18C; **and 79(5)**, H(1A: 3).

International Classification: —**B62d.**

COMPLETE SPECIFICATION

Improvements in or relating to the Steering System of a Vehicle

We, MARSHALL SONS & COMPANY LIMITED, a British Company, of Britannia Works, Gainsborough, Lincolnshire, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to an improved steering system for a vehicle of the kind comprising a differential gear having a pair of half-shafts driving ground-engaging members (i.e. tracks or wheels) and in which steering is effected, or assisted, by enforcing a difference in velocity of the two half-shafts relative to the body of the vehicle. For the sake of simplicity in the ensuing description and claims a vehicle of this kind will be refered to as a tractor.

One known type of tractor has two independently-operated brakes which are adapted to brake said half-shafts for the purpose of steering, or assisting the steering, of the tractor. The differential gear in this known tractor divides the torque equally between the ground-engaging member or members driven by one of the half-shafts and the ground-engaging member or members driven by the other half-shaft. Consequently, when one of the steering brakes is applied to lock the ground-engaging member or members driven by one of the half-shafts, the ground-engaging member or members driven by the unbraked half-shaft is, or are, driven at twice the speed existing immediately prior to the application of the brake, but with no increase in torque. This is a disadvantage since the added resistance to the slewing of the tractor is usually very heavy, which means that the engine will labour or even stall. A known means to reduce this effect is the "geared" or "Cletrac" type differential, in which a full application of a steering brake results not in a complete stopping of a half-shaft, but in causing it to rotate more slowly, and the other half-shaft correspondingly faster. This, however, makes it impossible to turn sharply in confined spaces.

The present invention provides a steering system for a tractor which ensures that ample driving torque is always available for turns, whilst the ability to make sharp turns by completely locking one ground-engaging member is not sacrificed. This implies the use of the simplest type of differential, but the invention is applicable also to vehicles provided with the "geared" or "Cletrac" differential, although the advantages gained from such a combination are less prominent.

According to the invention a steering system for a tractor of the kind hereinbefore specified and having steering brakes acting independently to enforce said difference in velocity of the two half-shafts, comprises means for lowering automatically the overall ratio of the change speed transmission upon application of a steering brake in order to meet the increased requirement for output torque presented by the change in direction of travel.

One form of steering system in accordance with the invention will now be described by way of example with reference to the accompanying drawings, in which

Fig. 1 is a schematic side view of part of the transmission and steering systems of a track-laying tractor, and

Fig. 2 is a plan corresponding to Fig. 1.

Referring to the drawings, the tractor transmission system comprises a variable-displacement pump 1, directly driven by an engine (not shown), which pump is connected to a hydraulic motor 2 via pipe lines 3 and 4. The overall ratio of the transmission is controlled in known manner by altering the tilt angle of the pump 1 by means of a control lever 5 and a rod 6. The lever 5 is pivotally mounted on a shaft 7 whilst one end of the rod is pivotally connected at 8 to the pump 1. The end of rod 6 remote from the pump 1 is pivotally connected at 9 to a block 10 which is slidably mounted in a slot 11 in the lever 5. The axis of the slot 11 passes through the

axis of shaft 7 and the block 10 is urged towards the lower extremity of the slot by a spring 12. The lever 5 may pivot about the axis 7 between limit positions defined by the lines A and B in Fig. 1. When not being actuated by the driver the lever 5 is held fixed by a spring loaded pawl 13 engaging a fine-toothed quadrant 14. The pawl 13 may be released from the quadrant 14 by a handle 15 pivotally mounted on the lever 5. The neutral position of the transmission system is obtained with the lever 5 substantially vertical (i.e. lying along the line C). Forward and reverse movements of the tractor are obtained by moving the layer 5 in the direction of the arrows D and E, respectively, the overall ratio of the transmission increasing as the lever 5 moves away from the line C.

Steering of the tractor is effected by steering levers 16 and 16*a* which operate brake bands 17 and 17a through steering rods 18 and 18*a*, respectively. In the drawings the bands 17 and 17*a* are shown in their "off" positions. Movement of the levers 16 and 16*a* in the direction of the arrow F causes the bands 17 and 17*a* to be applied to brake drums 19 and 19a, respectively. The latter are splined to the half shafts 20 and 20*a*, respectively, of the usual differential gear 21. The half shafts 20 and 20*a* carry pinions 22 and 22*a*, respectively, forming part of the final drives to the tracks (not shown) of the tractor. The crown wheel 23 of the differential gear 21 is driven by a pinion 24 splined to the shaft 25 of the motor 2.

The rod 6 is provided with a pad 26 against the underside of which cranked portions 27 and 27*a* of the steering levers 16 and 16*a*, respectively, bear. Movement of either of the steering levers 16 and 16*a* from the positions shown in the drawings in the direction of the arrow F, to steer the tractor, will cause the pad 26 to rise under the influence of the cranked portion 27 or 27*a*. This upward movement of the pad 26 forces the block 10 upwardly in the slot 11 and therefore automatically reduces the overall ratio of the transmission system by reducing the tilt angle of the pump 1.

Actuation of the control lever 5 does not affect the steering, and the ratio by which the tilt angle of the pump 1 is reduced by actuation of the lever 16 or 16*a* is substantially independent of the absolute value of the tilt angle, both for forward or reverse movement of the tractor. In other words the proportional lowering of the transmission ratio effected by actuation of a steering brake is substantially constant irrespective of the overall transmission ratio existing immediately prior to the actuation of the steering brake. Of course, if desired, the ratio by which the tilt angle of the pump 1 is reduced by actuation of the lever 16 or 16*a*, could be made to have different value in different positions of the lever 5 by suitably shaping the slot 11.

It will, of course, be appreciated that the accompaning drawings are purely schematic and that any hydraulic auxiliaries, such as servo-mechanisms, that may be required to reduce the driver's effort have been omitted for the sake of clarity.

Again, although the invention has been described in detail above with reference to a tractor having a substantially infinitely-variable transmission system, the invention may also be applied to tractors having gearboxes providing a few fixed ratios provided that the transition between these ratios can be achieved continuously without passing through a declutching (zero torque) phase. For example the transmission system may comprise an epicyclic gearbox with suitably overlapping friction bands. In this case each time a steering operation is made a lower gear ratio is selected in the gearbox.

WHAT WE CLAIM IS:—

1. A steering system for a tractor of the kind hereinbefore specified and having steering brakes acting independently to enforce said difference in velocity of the two half-shafts, comprising means for lowering automatically the overall ratio of the change speed transmission upon application of a steering brake in order to meet the increased requirement for output torque presented by the change in direction of travel.

2. A steering system as claimed in Claim 1 for a tractor having a substantially infinitely variable change-speed transmission, in which the proportional lowering of the transmission ratio effected by actuation of a steering brake is substantially constant irrespective of the overall transmission ratio existing immediately prior to the actuation of the steering brake.

3. A steering system as claimed in Claim 1 for a tractor having a gearbox enabling certain fixed gear ratios to be selected without interrupting the tractive effort, in which actuation of said steering brake causes a lower gear ratio to be selected in said gearbox.

4. A steering system for a tractor constructed and arranged substantially as herein described and as shown in the accompanying drawings.

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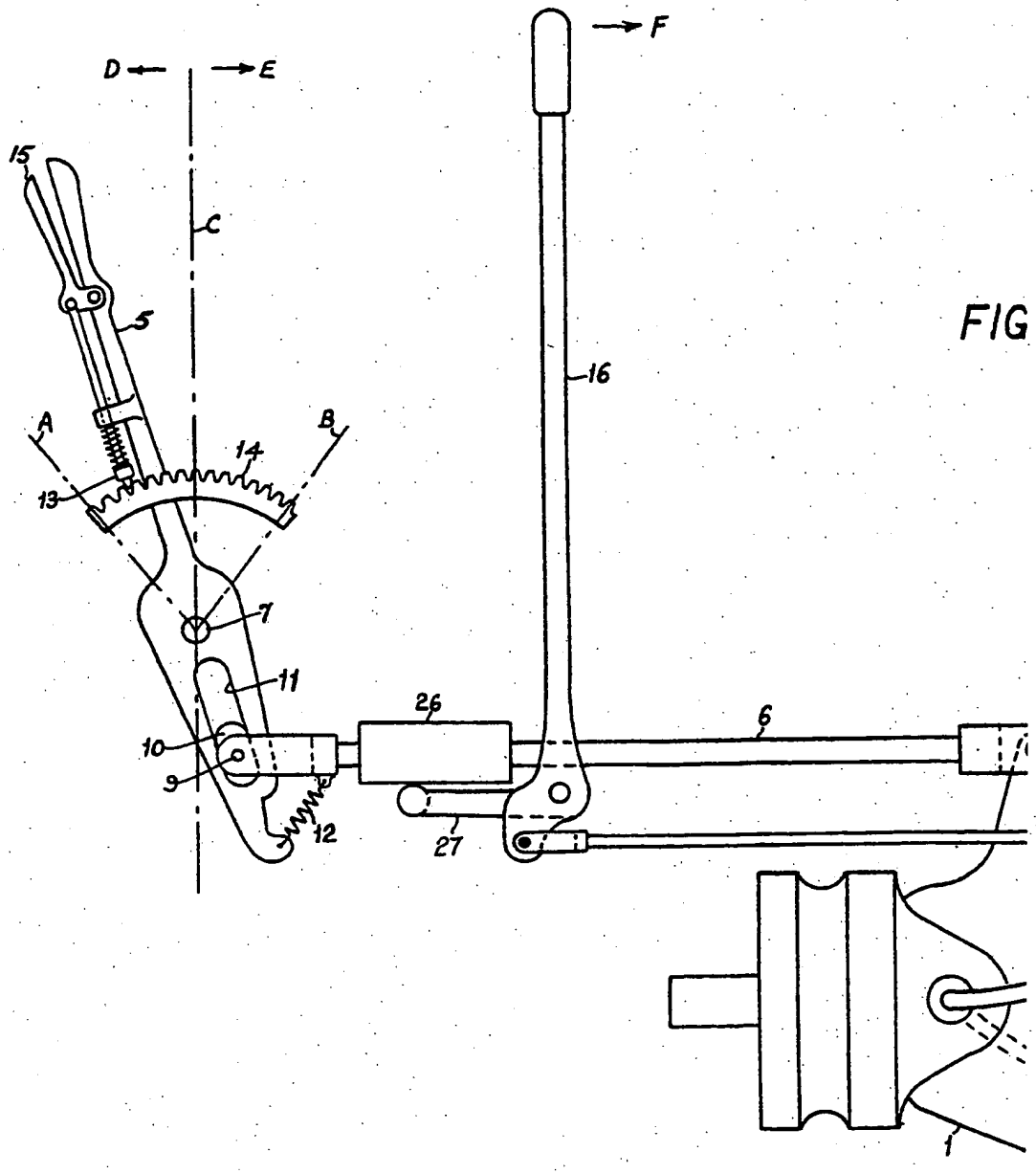
Leamington Spa: Printed for Her Majesty's Stationery Office, by the Courier Press.—1959.
Published at The Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies may obtained



FIG

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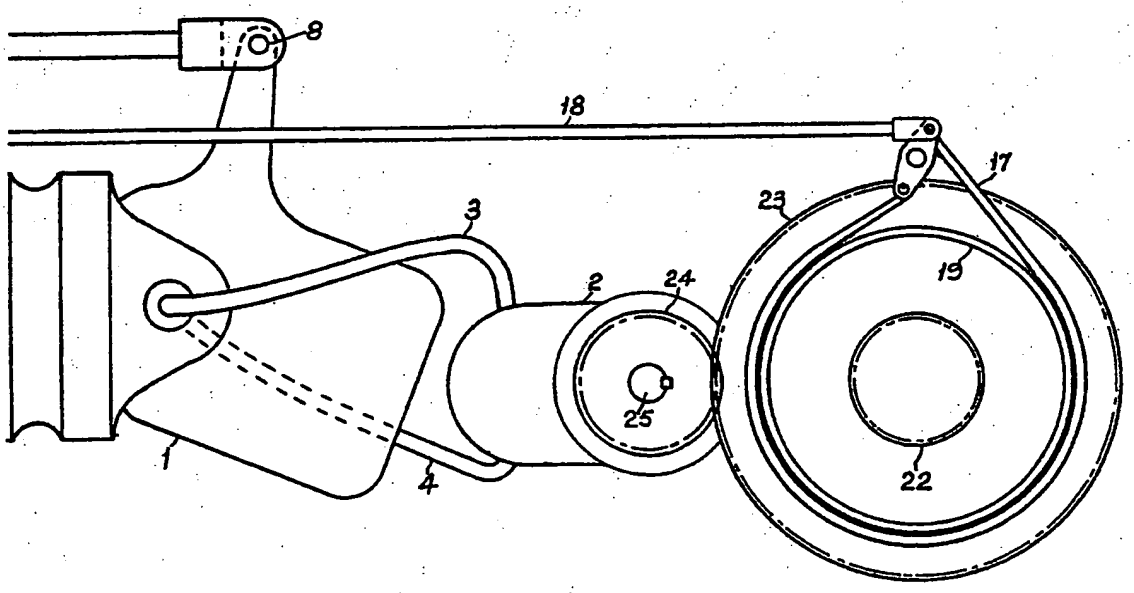
SHEET 1

FIG. 1



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SHEET 1

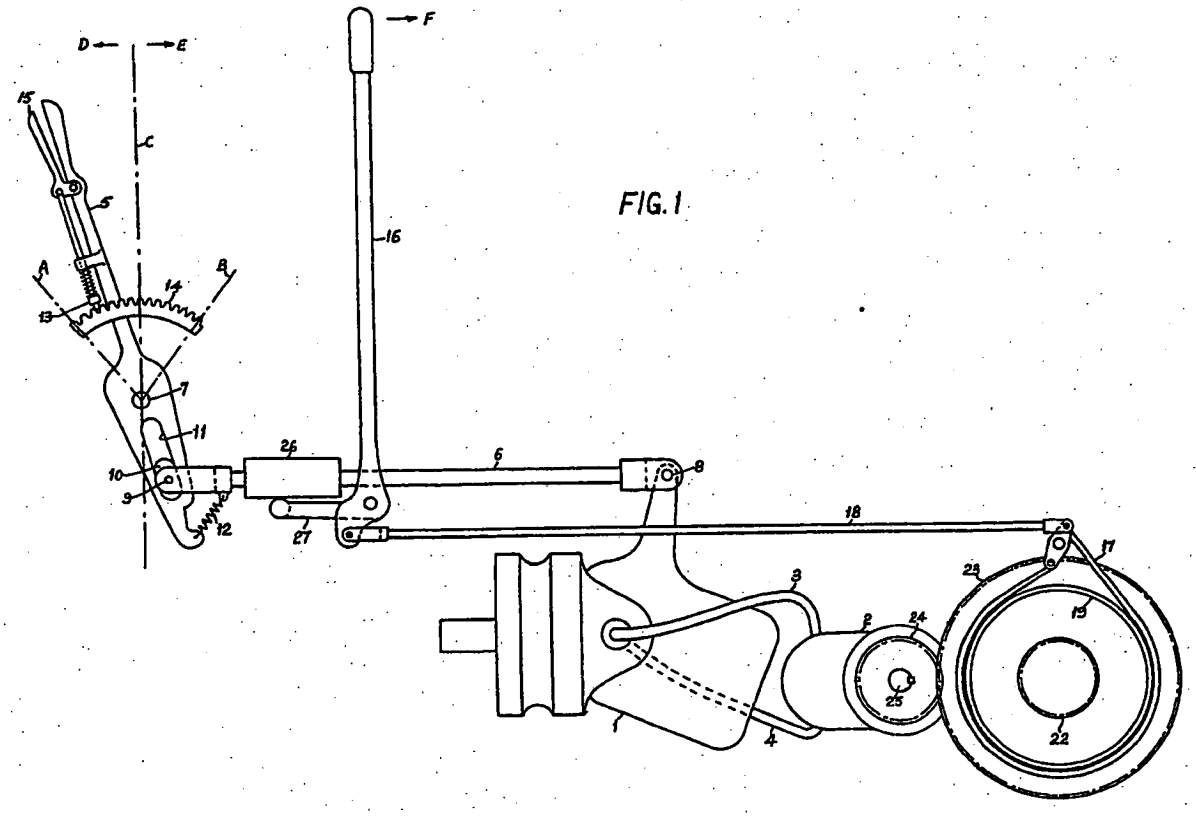
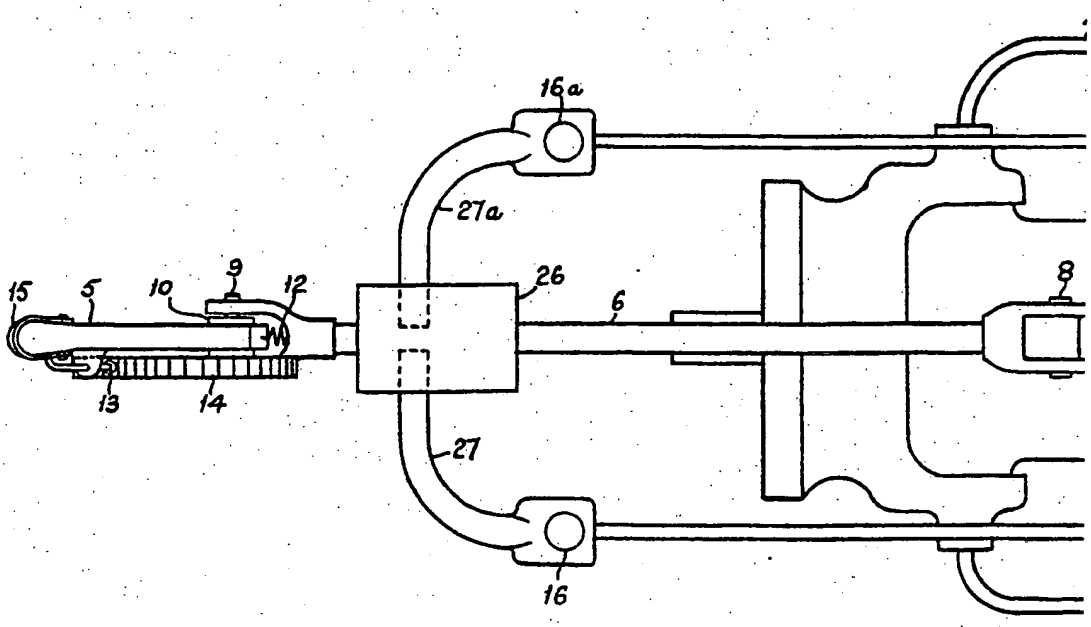


FIG. 1

FIG. 2



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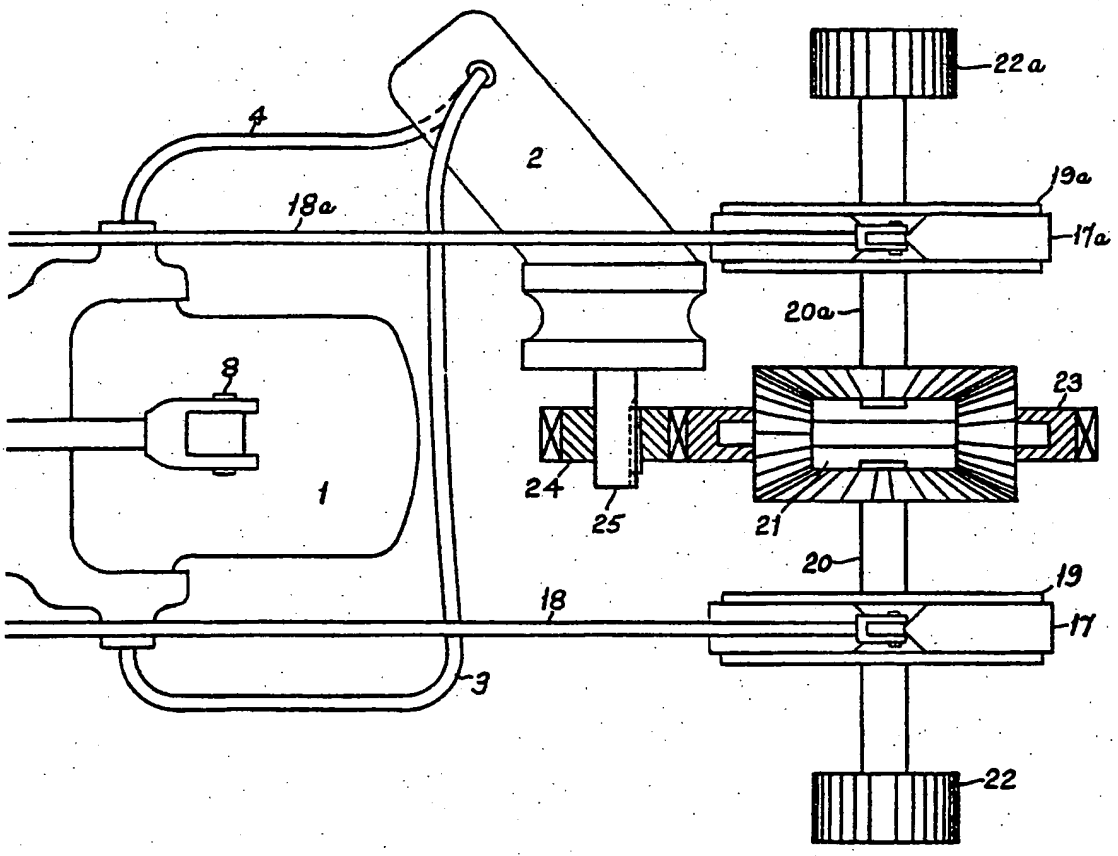

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SHEET 2

FIG. 2